# ACHIEVEMENTS OF THE EGYPTIAN IRON EXPLORATION PROJECT (IEP, 1993-1997)

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Prof. of Ore Geology, Cairo University, Faculty of Science, Geology Department, Egypt.

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## GEOLOGY OF THE ARAB WORLD (GAW 4)



**VOLUME 1** 

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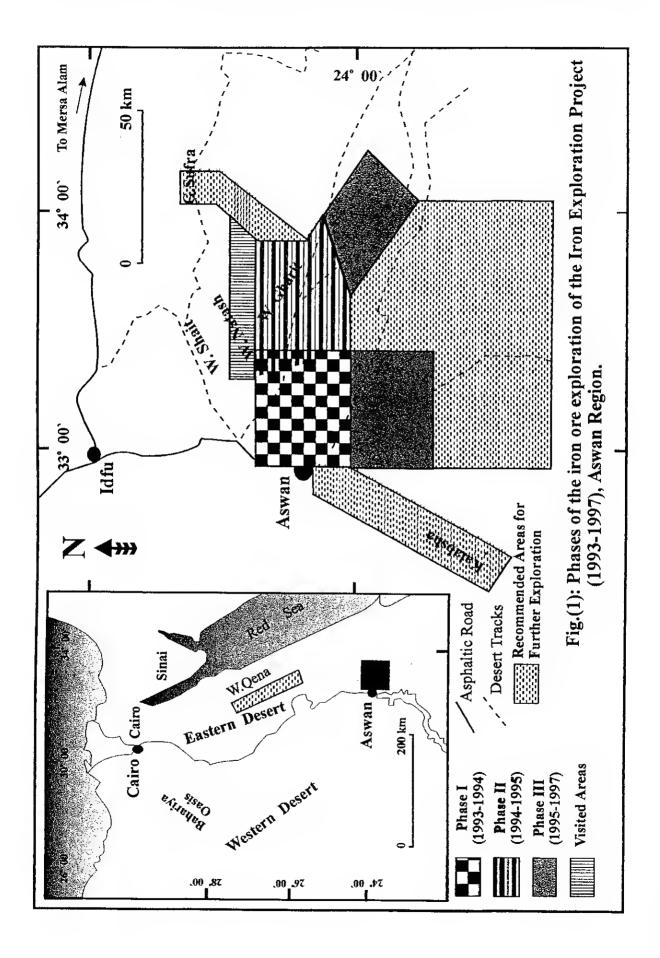
This report which summarizes the main goals, methodology, achievements and results of the Egyptian Iron Exploration Project (IEP, I993-I997), is presented here on behalf of the research groups. The relevant documents are included in the reports of phases I, II and III, and are accessible at HCMI, ISCO, EGSMA and the Geology Department, Cairo University.

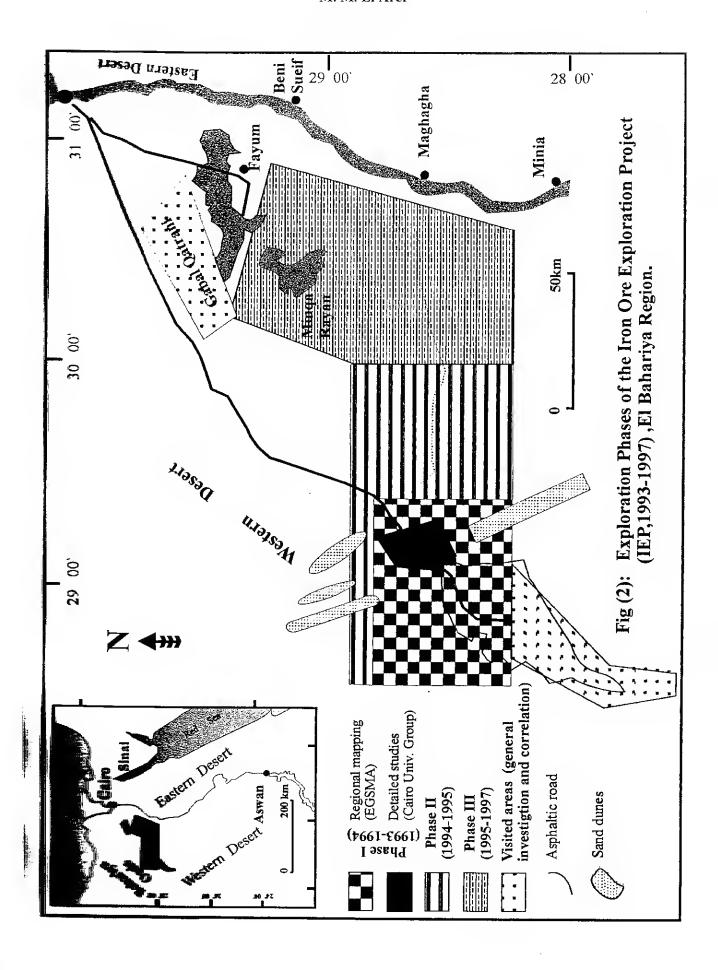
Egypt entered the field of iron and steel production in the I 950's. Aswan iron ore was shipped to the Iron and Steel Company (ISCO) at Helwan, about 900 km north of Aswan. The Complex was established close to the Nile River and Helwan residential area, near Cairo. Pollution problems were not addressed at that time. During the I960's news were circulated about the discovery of iron ore deposits surpassing those of Aswan. These deposits occur to the north of the El Bahariya Oases in the Western Desert, about 300 km west of Helwan. The Iron and Steel Complex switched to the El Bahariya Oases for iron ores, and Aswan was abandoned.

In the I990's, it was predicted that Egypt would face shortages in iron and steel production. New iron ore reserves were sought to secure the national economy. Several meetings, symposia and conferences were held to find a solution to this serious issue. In 1992, the Metallurgical Industries Corporation and the Ministry of Petroleum and Mineral Resources agreed to sign an agreement with Cairo University and the Egyptian Geological Survey and Mining Authority (EGSMA) to search for new iron ore deposits in Egypt.

The goal of the signed project is iron ore exploration based on geological merit, in Aswan and El Bahariya Regions. Figures I and 2 illustrate the different phases of iron exploration in these regions. The first phase of the IEP was to assess all previous studies and to visit all iron ore occurrences in the country. The working groups (Table 1) succeeded in identifying the nature of the problem, and proposed the plan of action for the second and third stages of the project. The field and laboratory activities of the IEP, conducted by EGSMA and Cairo University Groups, are shown in Table 2.

The future of iron ore mining in Egypt is bright and the evaluation of the deposits will indicate the optimum conditions for exploitation of the newly discovered iron ores. Incidentally, it is worth mentioning that President MUBARAK paid a visit to the newly discovered iron ores in the area southeast of Aswan. Investors are being invited to exploit these deposits in the light of the recent technologies for iron and steel production. The strategy of phase I was to conduct regional mapping on a scale of I: 25000, and to prepare a





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Metallurgical Industries Co. (MICOR)

Geology Department Cairo University,

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## - 13 -

	Table	Table (2) IEP.		nd Lab	Field and Lab. Activities (Phases I	es (Phe	ses   - iil)	11).				
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* Reconnaissance (km²)	-	400		950		1200	•	200	1070	900	704	1900
* Stratigraphic Sections (No. / metrage )	1	5/450	•	16/480	88/2468	13/325	39/549		102	12/120	15/400	7/210
* Trenches (No. / metrage)	64/2314	•	32/816	5/150	48/1162	9/82	•	5/50	847.66	28/224		
Structural, Subsurface, & Geomorphological maps (No.)	,	ı	•	=	,	4	-	10	ı	m		S
* Correlations (No.)	-	1		3	9	6	46			C		,
* 2-d & 3-d models (No.)	-			1				•	•	7		7
* Bore Holes (No. / metrage)	•			-	2/502		19/533 6		4/60		29/1570	-
* Samples collected (No.)	736	197	54	224	564	150	853	199	347	130	304	632
* Megascopic Examinations (No. of samples)	736	197	54	224	564	150	853	199	347	130	304	632
* Re-evaluation of Ore Reserves (No./km²)	•		•		4/501		•		•	•		
* New discoveries & Geological Evaluation	•	•				1763		2	9	2		-
(No./km²)		'	•	•	•	1/6.3			· ••	15	<u>س</u>	m
* Field photographs (No.)		150	•	300	70	200	100	350	150	200	150	200
Jecunological Samples (No.)	-	-	•	•	-		•		156		•	
<ul><li>Laboratory Studies:</li><li>* Palaeontologic Examination(No.)</li></ul>	.101	30		133	364						,	
* Thin Section Examination(No.)	169	235	54	12/2	236	- 001	- 5	150	.   0		62	, ,
* Polished Section Examination (No.)		59		40	2	100	12	305	2 6	4/0	7/	3 6
* Photomicrographs (No.)	•	40				200	! .	9	202	185		3
* Mineral Separation (No.)		25	1	20	•			3	3	-		
* XKD/Mineral Analysis (No.)	-	46	23	-	•	-				22		
Thermal Analyses (No.)	-	-	3	•	•		  -					
* Spectral Analyses & SEM (No.)		22	34	•	•					10		
* National Specific Analyses (No.)		•	2	•	30	•	•	•				
* VDC 6. 117. 0/	• ;	•	7	-	•	-	18		-			Ţ.
ANT & WI %a.	14	35	24		192	•	145		186			
* Doors	4	m	702	32	146	06	131	18	100	15	4.9	20
Neports	Phase		Report		Phase	11		Report	Phase		7	Report
3. Paleomagnetic studies			10/379									1
4. Geophysical Studies							1214/4km				3809/8кш	
5. Well Logging							355.1					

combined map on a scale of 1: 100 000. Previous work was revised, and the maps were prepared aiming to:

- 1. Clarify the field relationships between the different stratigraphic units which crop out in the examined areas of El Bahariya and Aswan.
- 2. Define geological and tectonic settings of the stratigraphic units which host the iron ores, in El Bahariya and Aswan Regions.
- 3. Determine the thickness of the iron ore bands by: (a) measuring thicknesses of the iron bands at the outcrops in the studied areas, (b) digging trenches and pits, and (c) selection of the best target areas for drilling bore holes to follow the subsurface extensions of the iron beds.
- 4. To determine the grade of the iron ore by laboratory techniques.

To achieve reliable mapping, the stratigraphy of both El Bahariya and Aswan Regions was the concern of both the EGSMA and Cairo University Groups. Therefore, joint field visits to exchange views and revise the known stratigraphy were planned and achieved during the progress of phase I of the study. Stratigraphic sections and trenches were prepared and measured, and the data communicated to the other working Group.

To understand the stratigraphic column properly, the structural framework of both regions had to be well constructed, and this was the task of the Cairo University Group.

New structural maps were prepared, especially for El Bahariya region, which was found to be more complicated than earlier realized. The structure is complicated, and hence the stratigraphy, by the interference of igneous activities in this region. The nature of the intrusive and extrusive rocks received careful attention, and paleomagnetic studies for assigning reliable ages to these igneous bodies were conducted by the Paleomagnetic department of EGSMA. The obtained results helped greatly in revising the modes of occurrence of the iron ores and the timing of igneous intrusion.

Following the presentation of the phase I results of the IEP, on Monday, 11<sup>th</sup> April 1 994, both the EGSMA and Cairo University Groups were engaged in regional mapping, detailed studies of selected sectors as well as excavations, trenching and drilling activities. The nature of the problem of searching for new iron ore occurrences was well understood, and this reliable concept was behind the successful results enclosed in the phase I report. The second phase of the IEP was oriented to fulfil two main goals:

- 1. Regional mapping of selected areas in El Bahariya and Aswan Regions (Figs. 1 & 2), using a scale of 1: 25000 for the plateau area, northeast of El Bahariya Depression, including El Bahr Depression, and a scale of 1:50 000 for East Aswan-Allawi district, west Aswan-Kalabsha sector and Wadi Garara sector. The geologic mapping focused on the stratigraphic setting and structural configuration of the concerned areas.
- 2. Regional exploration for the prospective occurrences of iron ore-bearing sedimentary sequences. In that context, the fundamental geologic aspects of the iron or host rock sequences in the El Bahariya (Upper Cretaceous-Middle Eocene) and Aswan (Upper Cretaceous) Regions were considered. This led to major assignments for new discoveries of iron ores in both regions.

The integration of the surface geologic data supplemented by the subsurface information from drilling and geophysical studies and mineralogical investigations during phases I and II

activities, revealed a certain number of geologic parameters/processes that act collectively in the formation and distribution scenario of the iron ore in both El Bahariya and Aswan Regions. The IEP work groups used the guide features of these parameters in evaluating the planned areas of phase III and predicting their prospective sectors. The fundamental geologic parameters and their effective roles in discovering new occurrences of iron ore in Aswan and El Bahariya Regions are outlined as follows.

#### Aswan Region

- 1. An exploration approach was adopted in Aswan in order to predict and evaluate the Cretaceous oolitic ironstone in the planned areas south and southeast of Aswan. From phase 1 and II prospection and discoveries, it was concluded that the economic oolitic ironstone beds commonly terminate the 2<sup>nd</sup>, and 3<sup>rd</sup> coarsening- upward cycles of the marine clastic sequence of the Coniacian- Santonian Timsah Formation.
- 2. The oolitic ironstone is recorded from Wadi Abu Subeira in the North to Wadi Um Bisili in the Southeast, Wadi Road Fl Kabsh in the East, and Barqet Tokham in the south, in beds of variable thicknesses, ranging from discrete laminae (few cm thick) to amalgamated beds up to 3m thick. Such variations occur from place to place, even locally within the same outcrop; but generally, wherever the oolitic beds occur, the clastic section assumes a coarsening-upward organization, and includes characteristic skolithos and marine trace fossils.
- 3. The present distribution of the Timsah Formation and its oolitic iron ore is mainly controlled by a set of NW-SE tensional faults. These faults dislocate the Cretaceous rocks of East and SE Aswan into a system of alternating NW-SW grabens and horsts with tilted fault blocks.
- 4. Based on these important observations, the exploration plan in phase III was oriented to delineate the fault blocks in which the Timsah Formation is exposed at the surface with a thin veneer of the overlying Um Barmil Formation (as overburden), also, to inspect the formation sedimentologic affinity and heirarchy, whether of marine or fluvial regime. Fortunately, these parameters were realised in El Dabaa block, west of Road El Kabsh, and south of Aswan along the Aswan Allaqi asphaltic road, at the occurrences of km 21, km 23. East Um Hibal, North and Central Wadi Arab, East Wadi Arab, Barqet Tokham and end of Khur Rahma. The pre-1976 recorded ore reserves of Aswan, and the newly discovered and re- evaluated reserves by the IEP (1993-1997), are shown in Table 3.

#### El Bahariya Region

Six geologic factors are recognized including:

1) Cretaceous wrench faulting, (2) Lutetian and Bartonian facies types and lateral changes, (3) Sym and post- Lutetian exposure and consequent karstification, (4) Syn-Bartonian exposure lateritization, (5) Stratiform setting of the Cenomanian ironstone, and (6) Post-Eocene extensional faulting and formation of discrete grabens.

In phase III. the east El Bahariya areas comprising Darb El Rayan, Darb El Masaudi, Darb El Bahariya it the Nile Valley, were planned for iron ore exploration. These areas represent the normal eastern extension of the Lutetian and Bartonian iron-hosting rocks of the Bahariya region, and also the trend of the NE-SW Cretaceous wrench faulting.

U-ortunately, the interpreted unique geologic setting and its marker features which are

intimately related to the above-mentioned interlocked geologic processes, are not met with or verified in the eastern areas. The deformation magnitude of the wrench faults, and consequent dislocation of the Cretaceous rocks to form discrete highs and lows prior to Eocene transgression, were probably mild or terminated in these sectors. Accordingly, the erosion processes subsequent to upper Cretaceous deformation did not expose, or completely stripped out, the iron ore-bearing rocks, shedding clastics of the Cenomanian deposits (Bahariya Formation). The latter opinion could be confirmed at El Nashfa anticline (along Darb El Bahnassawi) which proved by drilling to be a paleohigh, where the Precambrian granitic basement rocks are penetrated at shallow depths through overlying Cretaceous successions.

The Lutetian and Bartonian facies of these areas are represented mainly by shallow marine and poorly ferruginous bank carbonates and marls, similar to those existing in the areas between the iron-ore hosting localities of El Harra, Ghorabi and El Gedida, although the glauconitic mudstone and greensand interbeds of the Bartonian rocks are intensively bioturbated and highly fossiliferous, reflecting a relatively quiet and open marine circulation. These glaucony facies differ from those existing in El Gedida mine while being isochronous. The latter is very poorly fossiliferous with several syndepositional alteration features suggesting deposition in a very shallow, ecologically unfavourable intertidal flat or estuary. This geologic setting, different from that modeled for El Bahariya mine areas (phases I and II), precludes the possibility of the existence of economic iron ore deposits at least of the Eocene type, in East El Bahariya-West El Minia area.

The disappointing results achieved from East El Bahariya-Nile Valley District, led the work Groups to return to El Bahariya region and to focus their attention and plans on developing the iron-hosting localities, namely, El Harra and El Gedida mine areas. Five development extensions were outlined and subjected to detailed exploration studies using geophysical techniques and a system of shallow pits, trenches and exploratory wells. The outlined extensions comprise:

- 1. Northeast El Harra (3 km<sup>2</sup>).
- 2. South El Gedida (4,5 km²).
- 3. West El Gedida (2km²).
- 4. East El Gedida (3km²).
- 5. North El Gedida El Ghaziya (>20 km²).

These extensions were recommended for exploration as the Lutetian deposits are interpreted to be accumulated near or along the slopes of the Cretaceous culminations and hence, the influences of the above-mentioned controlling factors probably extended to reach these areas. However, the exposed Lutetian rocks in these sectors are completely of karstified carbonate facies, representing the lower and middle parts of the Naqb Formation.

The presence of this carbonate facies minimizes the opportunity to find its equivalent of proper economic pisolitic and nummulitic ironstone. Hence, the planned exploration work in these sectors was restricted to predicting the Lower Cenomanian stratiform ironstones, that assume a thickness ranging from few centimeters up to I0m, and/or the karstified iron ore

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Wadii         Image: Section of Cabal Ell         12,558,000         Past Wadi         88,000,000         9a         Dabaa         12,558,000           Allawi         S.378,825         S. 578,825         S. 578,825         S. 578,825         S. 578,825         S. 578,000         West         Image: Info@00,000         Info@00,000         Info@00,000         Info@00,000         West         Info@00,000         Inf	Wadii         II         Beida Um beissa         East Wadi         88,000,000         9a         Dabaa         12,558,000           Aweirsha Beida Um Beida Um Hugban Allawi Allawi         15,951,250         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20         20	Wadii         II         East Wadi         88,000,000         9a         Dabaa         12,558,000           Aweirsha         Beida Um         Beida Um         Beida Um         Bargat Tukham         11,000,000         West         West         West         In         Bargat Tukham         7,000,000         West         In         Bargat Tukham         7,000,000         Total Geological         Total Geological <td< td=""><td>Wadii         Image: Second Section of Section Sectio</td><td>  Morking Group   EGSMA   EGSMA   EGGlogy Department    </td><td>  Cocality   Reserve   Exploration Phases   Locality   Reserve (in Tonage)   EGSMA   Cairo University   Cair</td><td></td><td></td><td></td><td></td><td>2000</td><td>Wadi Arab</td><td></td><td>(L(</td><td>_</td><td>—</td></td<>	Wadii         Image: Second Section of Section Sectio	Morking Group   EGSMA   EGSMA   EGGlogy Department	Cocality   Reserve   Exploration Phases   Locality   Reserve (in Tonage)   EGSMA   Cairo University   Cair					2000	Wadi Arab		(L(	_	—
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Wadi Um Udi         1,270,500         Wadi Arab         8 North and Central Wadi Arab         19,000,000         9a         Dabaa           Wadi Arab Beida Um Beida Um Hugban Allawi Arab Beida Um Asta Beida Um Arab Hugban Allawi Allawi Bast         26,592,843         Shadi Arab Arab Arab Arab Arab Beida Um Arab Arab Arab Allawi	Wadi Um Udi         1,270,500         Wadi Arab         8 North and Central Wadi Arab         19,000,000         9a         Dabaa         12,558,000           Wadi Arab Beida Um Beida Um Huqban Allawi Asta Salabini and Arab Beida Um Allawi Allawi Allawi Bast Allawi Al	Wadi Um Udi         1,270,500         Reserve         8 North and Central Madi Arab         19,000,000         9a         Dabaa           Wadi Um Vadi Wadi Arab         Wadi Arab         Wadi Arab         Arab         Arab         Dabaa         12,558,000           Hugban West Hugban Allawi         S. 378,825 Good Allawi         S. 378,7261 Good Allawi <td>Wadi Um Udi         1,270,500         Reserve         North and Central Wadi Arab Wadi Arab         North and Central Wadi Arab Wadi Arab Wadi Arab Wadi Arab         Dabaa         Dabaa         12,558,000           Aluawi East         8,378,825 % 6,073,550         6,073,550         6,073,550         77,847,261         77,847,261</td> <td>  Cocality   Reserve   Exploration Phases   Locality   Reserve   EGSMA   Cairo University   Reserve   Cairo University   Reserve   Cairo University   North Aweirsha   15.596,822   9c   Rod El Kabash   32,917,500    </td> <td>  Reserve   Reserve   Exploration Phases   Locality   Reserve   Lotal Proved   T4,765,380   Reserve   Total Reserve   T4,765,380   Reserve   Lotal Reserve   Lotal</td> <td></td> <td></td> <td>East</td> <td></td> <td>100,000,000</td> <td>East Um Hebal</td> <td>2</td> <td>1</td> <td><math>\perp</math></td> <td>+</td>	Wadi Um Udi         1,270,500         Reserve         North and Central Wadi Arab Wadi Arab         North and Central Wadi Arab Wadi Arab Wadi Arab Wadi Arab         Dabaa         Dabaa         12,558,000           Aluawi East         8,378,825 % 6,073,550         6,073,550         6,073,550         77,847,261         77,847,261	Cocality   Reserve   Exploration Phases   Locality   Reserve   EGSMA   Cairo University   Reserve   Cairo University   Reserve   Cairo University   North Aweirsha   15.596,822   9c   Rod El Kabash   32,917,500	Reserve   Reserve   Exploration Phases   Locality   Reserve   Lotal Proved   T4,765,380   Reserve   Total Reserve   T4,765,380   Reserve   Lotal			East		100,000,000	East Um Hebal	2	1	$\perp$	+
Wadi Um Udi         1,270,5000         East Um Hebal         100,000,000         Papera         12,558,000         Mest Um Hebal         11,000,000         Mest Um Hebal         11,000,000         Mest Um Hebal         11,000,000         Mest Um Hebal         12,558,000         Mest Um Hebal         11,000,000         Mest Um Hebal         11,000,000         Mest Um Hebal         12,558,000         Mest Um Hebal         11,000,000         Mest Um Hebal <td>Wadi Um Udi         1,270,5000         East         100,000,000         East           Wadi Um Udi         1,270,500         East Wadi Arab         8 North and Central 19,000,000         19a         Dabaa           Aweirsha Esta Um Hugban         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843</td> <td>Wadi Um Udi         1,270,500         East         100,000,000         East           Wadi Um Udi         1,270,500         East Wadi Arab         100,000,000         Pa Dabaa         12,558,000           Wadi Um Udi         1,270,500         East Wadi Arab         8,000,000         Pa Dabaa         12,558,000           Aleia Um East Wadi         8,378,825         Chap Sing Sing Sing Sing Sing Sing Sing Sing</td> <td>Wadi Um Udi         1,270,500         East         100,000,000         East           Wadi Um Udi         1,270,500         East Wadi Arab         100,000,000         9a         Dabaa           Aweirsha         26,592,843         Sanda Um Arab         Sanda Arab         Sanda Arab         Balawi         88,000,000         9a         Dabaa           Hugban West         Sanda Singa Si</td> <td>  Locality   Reserve   Exploration Phase   Locality   Re-evaluated   Locality   Reserve   Locality   Re-evaluated   Locality   Re-evaluated   Locality   Reserve   Locality   Re-evaluated   Locality   Reserve   Locality   Reserve   Locality   Reserve   Reserve   Locality   Reserve   Res</td> <td>  Reserve   Reserve   Exploration Phases   Locality   Reserve   Locality</td> <td></td> <td></td> <td></td> <td>7</td> <td>2,000,000</td> <td>╣.</td> <td></td> <td></td> <td>L</td> <td>!-</td>	Wadi Um Udi         1,270,5000         East         100,000,000         East           Wadi Um Udi         1,270,500         East Wadi Arab         8 North and Central 19,000,000         19a         Dabaa           Aweirsha Esta Um Hugban         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843         26,592,843	Wadi Um Udi         1,270,500         East         100,000,000         East           Wadi Um Udi         1,270,500         East Wadi Arab         100,000,000         Pa Dabaa         12,558,000           Wadi Um Udi         1,270,500         East Wadi Arab         8,000,000         Pa Dabaa         12,558,000           Aleia Um East Wadi         8,378,825         Chap Sing Sing Sing Sing Sing Sing Sing Sing	Wadi Um Udi         1,270,500         East         100,000,000         East           Wadi Um Udi         1,270,500         East Wadi Arab         100,000,000         9a         Dabaa           Aweirsha         26,592,843         Sanda Um Arab         Sanda Arab         Sanda Arab         Balawi         88,000,000         9a         Dabaa           Hugban West         Sanda Singa Si	Locality   Reserve   Exploration Phase   Locality   Re-evaluated   Locality   Reserve   Locality   Re-evaluated   Locality   Re-evaluated   Locality   Reserve   Locality   Re-evaluated   Locality   Reserve   Locality   Reserve   Locality   Reserve   Reserve   Locality   Reserve   Res	Reserve   Reserve   Exploration Phases   Locality   Reserve   Locality				7	2,000,000	╣.			L	!-
Gabal Timsah         21,490,000         Honor of the control of the c	Gabal Timsah         21,490,000         Honor, 100         East Um Hebal         100,000,000         Beat Um Hebal         100,000,000         Beat Um Hebal         100,000,000         Beat Um Hebal         11,000,000         Beat Um Hebal         11,000,000         Mest Um Hebal         11,000,000	Gabal Timsah         21,490,000         Househ         10,000,000         East           Wadi Um Udi         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,500         1,270,	Gabal Timsah         21,490,000         Host of the control of the con	Cocality   Reserve   EGSMA   Cairo University   Cin Tonage   Exploration Phases   Locality   Reserve   Cairo University   Cai	Reserve   Before 1976   Working Group   EGSMA   Geology Department		107,887,50		3	000000		۲		9.129.925	
Ras Aqaba         9,129,925         7         Road         K. 29         9,000,000         East         05,209,201           Gabal Timsah         21,490,000         Wadi Um Udi         1,270,500         10         East Um Hebal         100,000,000         East         100,000,000         East         12,558,000           Wadi Um Udi         1,270,500         East Wadi         Reserve         12         East Wadi         Reserve         11,000,000         Pa         Dabaa         12,558,000           Wadi Um Udi         1,270,500         East Wadi         88,000,000         Pa         Dabaa         12,558,000           Aweirsha         2,6,592,843         \$\frac{\theta}{2}\$         \$\frac{\theta}{2}\$         \$\frac{\theta}{2}\$         \$\frac{\theta}{2}\$         \$\frac{\theta}{2}\$           Hugban         \$\frac{\theta}{2}\$         \$\frac{\theta}{2}\$         \$\frac{\theta}{2}\$         \$\frac{\theta}{2}\$         \$\frac{\theta}{2}\$         \$\frac{\theta}{2}\$           Allawi         \$\frac{\theta}{2}\$	Ras Aqaba   9,129,925   Cabal Filmsah   21,490,000   East Um Hebal   100,000,000   East   Cabal Filmsah   21,490,000   East Um Hebal   100,000,000   East   Cabal Elast	Ras Aqaba   9,129,925   Gabal Timsah   21,490,000   East   Morth and Central   100,000,000   East   Madi Arab   Morth and Central   10,000,000   East   Madi Arab   Most   East   Madi Arab   East   Eas	Ras Aqaba   9,129,925   Gabal Timsah   21,490,000   East Um Hebal   100,000,000   East   Cabal Timsah   21,490,000   East Um Hebal   100,000,000   East   Cabal Timsah   21,490,000   East Wadi Arab   Cabal Timsah	Cocality   Reserve   EGSMA   Cairo University   Caelogy Department	Reserve   Before 1976   Working Group   EGSMA   Geology Department		170 000 27	Dabaa	ć	12,000,000		9		00.4.0000	4
Ras Agaba   9,129,925   Gabal Finnsah   21,490,000   9b   Dabaa   65,289,261     Ras Agaba   9,129,925   Gabal Finnsah   21,490,000   10   East Um Hebal   100,000,000   East     Wadi Um Udi   1,270,500   East Um Hebal   100,000,000   East     Wadi Um Udi   1,270,500   East Wadi Arab   East Wadi Arab   East Wadi Arab   East Wadi Arab     Wadi Um Udi   1,270,500   East Wadi Arab   East Wadi Arab     Beida Um	Ras Agaba   9,129,925   Gabal Timsah   21,490,000   9 b Dabaa   65,289,261   1,490,000   1,270,500   10   East Um Hebal   100,000,000   East   Wadi Arab   East   Wadi Arab   East   Hopon   East   East   Hopon   East   East   Hopon   East   East   Hopon   East	Ras Aqaba   9,129,925   Road   K. 29   12,000,000   9b   Dabaa   65,289,261     Gabal Timsah   21,490,000   10   East Um Hebal   100,000,000   East     Wadi Um Udi   1,270,500   Madi Arab   Roserve   East Wadi   Roserve   East   Road   R. 29   9,000,000   East     Wadi Um Udi   1,270,500   East Wadi   Roserve   East Wadi   Roserve   East   East   East Wadi   Roserve   East   East   East Wadi   East Wadi   East Wadi   Roserve   East   East   East Wadi   East West   East Wadi   East   East Wadi   East   East Wadi   East   East Wadi   East   East   East Wadi   East   Eas	Ras Aqaba   9,129,925   Road   K. 29   12,000,000   9b   Dabaa   65,289,261	Locality   Reserve   Exploration Phases   Locality   Reserve   I.418,750     North Wadi   South   South Wadi   South   South	Reserve   Before 1976   Working Group   EGSMA   Cairo University   EGSMA   Cairo University   Cairo Univer					3.000.000		n		3 800 438	
Um Esh         3,899,438         6 Alaqi         K. 21         3,000,000         9b         Dabaa         65,289,261           Ras Aqaba         9,129,925         10 East Um Hebal         12,000,000         9b         Dabaa         65,289,261           Wadi Um Udi         1,270,500         Wadi Um Udi         1,270,500         North and Central         10,000,000         Past Um Hebal         100,000,000         Bast           Wadi Um Udi         1,270,500         Wadi Arab         North and Central         19,000,000         Past         Dabaa         11,558,000           Wasi Eda Um Udi         1,270,500         Past         Past Wadi Arab         88,000,000         Past         Dabaa         12,558,000           Wasi Eda Um Udi         1,5951,250         9         East Wadi Arab         88,000,000         West         Nest           Allawi         26,073,550         9         East Wadi Tukham         7,000,000         West         Total Geological         Total Geological           Balawi         26,073,550         Reserve         Reserve         Reserve         Reserve	Um Esh         3,899,438         S Aswan - K. 21         K. 21         3,000,000         9b         Dabaa         65,289,261           Ras Aqaba         9,129,925         17         Road         K. 23         12,000,000         9b         Dabaa         65,289,261           Gabal Timsah         21,490,000         1,270,500         10         East Um Hebal         100,000,000         East         East           Wadi Um Udi         1,270,500         Wadi Arab         8         North and Central         100,000,000         Pa         East           Aweirsha         2 6,592,843         \$ Parab         \$ S,378,825         \$ Parab         \$ Dabaa         12,558,000           West         15,551,250         \$ Parab         11         End Khor Rahma         11,000,000         West         12,558,000           Allawi         \$ 6,073,550         \$ 6,073,550         \$ Parab         Total Geological         240,000,000         Total         Total           Gabai East         \$ 6,073,550         \$ Parab         Total Geological         240,000,000         Total         Reserve           Gabai East         \$ 6,073,550         \$ Parab         Parab         Parab         Parab         Parab         Parab         Parab         Parab <td>Um Esh         3,899,438         S Aswan - K. 21         K. 21         3,000,000         pb         Dabaa         65,289,261           Ras Aqaba         9,129,925         10,000,000         12,000,000         9b         Dabaa         65,289,261           Gabal Timsah         21,490,000         10         East Um Hebal         100,000,000         East         East           Wadi Um Udi         1,270,500         Wadi Um Udi         1,270,500         Beida Um Udi         1,000,000         Bast         Bast         Bast Wadi         Bast Wadi         Bast         Bast         Bast Wadi         Bast         Bast         Bast Wadi         Bast         <t< td=""><td>Um Esh         3,899,438         5 Aswan - K. 21         3,000,000         9b         Dabaa         65,289,261           Ras Aqaba         9,129,925         3,000,000         9b         Dabaa         65,289,261           Gabal Timsah         21,490,000         10         East Um Hebal         100,000,000         East           Wadi Um Udi         1,270,500         8         North and Central         16,000,000         9a         Dabaa           Aweirsha Beida Um West         26,592,843         \$\frac{\alpha}{\alpha} = \frac{\alpha}{\alpha} = \f</td><td>  Locality   Reserve   Exploration Phases   Locality   Reserve   Re</td><td>Reserve         Exploration Phases         Locality         Reserve (In Tonage)         Exploration Phases         Locality         Reserve (In Tonage)         Exploration Phases         Locality         Reserve (In tonage)         EGSMA         Cairo University           North Wadi         11,418,750         In North Aweirsha         11,953,689         9c         Rod El Kabash         32,917,500           Abu Subeira         8,032,500         In North Aweirsha         12,784,750         In Huqban         12,784,750           Wadi Abu Subeira         1,419,000         In Huqban         In Allawi         In Allawi         In Interval Interval         Interval Interval           Wadi Abu Subeira         1,419,000         Interval Interval         Interval Interval         Interval Interval         Interval Interval           Wadi Abu Subeira         1,419,000         Interval Interval         Interval Interval         Interval Interval         Interval Interval         Interval Interval           Wadi Abu         Interval Interval         Interval Interval         Interval Interval         Interval Interval         Interval Interval</td><td>Phase</td><td></td><td>Reserve</td><td></td><td></td><td>Reserve</td><td></td><td></td><td></td><td>Agas</td></t<></td>	Um Esh         3,899,438         S Aswan - K. 21         K. 21         3,000,000         pb         Dabaa         65,289,261           Ras Aqaba         9,129,925         10,000,000         12,000,000         9b         Dabaa         65,289,261           Gabal Timsah         21,490,000         10         East Um Hebal         100,000,000         East         East           Wadi Um Udi         1,270,500         Wadi Um Udi         1,270,500         Beida Um Udi         1,000,000         Bast         Bast         Bast Wadi         Bast Wadi         Bast         Bast         Bast Wadi         Bast         Bast         Bast Wadi         Bast         Bast <t< td=""><td>Um Esh         3,899,438         5 Aswan - K. 21         3,000,000         9b         Dabaa         65,289,261           Ras Aqaba         9,129,925         3,000,000         9b         Dabaa         65,289,261           Gabal Timsah         21,490,000         10         East Um Hebal         100,000,000         East           Wadi Um Udi         1,270,500         8         North and Central         16,000,000         9a         Dabaa           Aweirsha Beida Um West         26,592,843         \$\frac{\alpha}{\alpha} = \frac{\alpha}{\alpha} = \f</td><td>  Locality   Reserve   Exploration Phases   Locality   Reserve   Re</td><td>Reserve         Exploration Phases         Locality         Reserve (In Tonage)         Exploration Phases         Locality         Reserve (In Tonage)         Exploration Phases         Locality         Reserve (In tonage)         EGSMA         Cairo University           North Wadi         11,418,750         In North Aweirsha         11,953,689         9c         Rod El Kabash         32,917,500           Abu Subeira         8,032,500         In North Aweirsha         12,784,750         In Huqban         12,784,750           Wadi Abu Subeira         1,419,000         In Huqban         In Allawi         In Allawi         In Interval Interval         Interval Interval           Wadi Abu Subeira         1,419,000         Interval Interval         Interval Interval         Interval Interval         Interval Interval           Wadi Abu Subeira         1,419,000         Interval Interval         Interval Interval         Interval Interval         Interval Interval         Interval Interval           Wadi Abu         Interval Interval         Interval Interval         Interval Interval         Interval Interval         Interval Interval</td><td>Phase</td><td></td><td>Reserve</td><td></td><td></td><td>Reserve</td><td></td><td></td><td></td><td>Agas</td></t<>	Um Esh         3,899,438         5 Aswan - K. 21         3,000,000         9b         Dabaa         65,289,261           Ras Aqaba         9,129,925         3,000,000         9b         Dabaa         65,289,261           Gabal Timsah         21,490,000         10         East Um Hebal         100,000,000         East           Wadi Um Udi         1,270,500         8         North and Central         16,000,000         9a         Dabaa           Aweirsha Beida Um West         26,592,843         \$\frac{\alpha}{\alpha} = \frac{\alpha}{\alpha} = \f	Locality   Reserve   Exploration Phases   Locality   Reserve   Re	Reserve         Exploration Phases         Locality         Reserve (In Tonage)         Exploration Phases         Locality         Reserve (In Tonage)         Exploration Phases         Locality         Reserve (In tonage)         EGSMA         Cairo University           North Wadi         11,418,750         In North Aweirsha         11,953,689         9c         Rod El Kabash         32,917,500           Abu Subeira         8,032,500         In North Aweirsha         12,784,750         In Huqban         12,784,750           Wadi Abu Subeira         1,419,000         In Huqban         In Allawi         In Allawi         In Interval Interval         Interval Interval           Wadi Abu Subeira         1,419,000         Interval Interval         Interval Interval         Interval Interval         Interval Interval           Wadi Abu Subeira         1,419,000         Interval Interval         Interval Interval         Interval Interval         Interval Interval         Interval Interval           Wadi Abu         Interval Interval         Interval Interval         Interval Interval         Interval Interval         Interval Interval	Phase		Reserve			Reserve				Agas
Um Esh         3,899,438         Reserve         Reserve           Um Esh         3,899,438         6 Alaqi         K. 21         3,000,000         9b         Dabaa         65,289,261           Ras Aqaba         9,129,925         Road         K. 29         9,000,000         B         Dabaa         65,289,261           Wadi Um Udi         1,270,500         B         North and Central         10,000,000         Bast Um Hebal         10,000,000         Bast Wadi Arab         Beida Um Hebal         10,000,000         Bast Wadi Arab         Bast Wadi Arab <t< td=""><td>Um Esh         3,899,438         Reserve         Reserve         Reserve           Um Esh         3,899,438         6 Alaqi         K. 21         3,000,000         9b         Dabaa         65,289,261           Ras Aqaba         9,129,925         7 Road         K. 29         9,000,000         B         Dabaa         65,289,261           Wadi Um Udi         1,270,500         Beida Um Udi         1,270,500         B         North and Central         100,000,000         Bast Um Udi         1,200,000         Bast           Wadi Um Udi         1,270,500         Beida Um Udi         Bast Wadi Arab         Ras,000,000         Bast         Bast         Bast Wadi Arab         Bast Wadi Arab</td><td>  Um Esh   3,899,438   Saswan</td><td>  Um Esh   3,899,438</td><td>  Locality   Reserve   Exploration Phases   Locality   Reserve   Exploration Phases   Locality   Reserve   Exploration Phases   Locality   Reserve   Exploration Phases   Locality   Reserve   Locality   Reserve   Rese</td><td>Reserve         Exploration Phases         Locality         Reserve (in Tonage)         Reserve (in tonage)         New Estimated           North Wadi         1,068,813         2         South Aweirsha         11,953,689         9c         Rod El Kabash         32,917,500           Abu Subeira         8,032,500         2         3         Um Huqban         12,784,750           Worth Wadi         1,419,000         2         Allawi         34,430,119</td><td>107.682</td><td>32.917.500</td><td>Total Geological</td><td></td><td>74,765,380</td><td>Total Proved</td><td></td><td>r)</td><td>5.159,700</td><td></td></t<>	Um Esh         3,899,438         Reserve         Reserve         Reserve           Um Esh         3,899,438         6 Alaqi         K. 21         3,000,000         9b         Dabaa         65,289,261           Ras Aqaba         9,129,925         7 Road         K. 29         9,000,000         B         Dabaa         65,289,261           Wadi Um Udi         1,270,500         Beida Um Udi         1,270,500         B         North and Central         100,000,000         Bast Um Udi         1,200,000         Bast           Wadi Um Udi         1,270,500         Beida Um Udi         Bast Wadi Arab         Ras,000,000         Bast         Bast         Bast Wadi Arab	Um Esh   3,899,438   Saswan	Um Esh   3,899,438	Locality   Reserve   Exploration Phases   Locality   Reserve   Exploration Phases   Locality   Reserve   Exploration Phases   Locality   Reserve   Exploration Phases   Locality   Reserve   Locality   Reserve   Rese	Reserve         Exploration Phases         Locality         Reserve (in Tonage)         Reserve (in tonage)         New Estimated           North Wadi         1,068,813         2         South Aweirsha         11,953,689         9c         Rod El Kabash         32,917,500           Abu Subeira         8,032,500         2         3         Um Huqban         12,784,750           Worth Wadi         1,419,000         2         Allawi         34,430,119	107.682	32.917.500	Total Geological		74,765,380	Total Proved		r)	5.159,700	
Wadii Um Udi         1,270,500         Total Proved         74,765,380         Total Geological         32,917,500           Um Esh         3,899,438         5 Aswan - K.21         3,000,000         9b         Dabaa         55,289,261           Ras Aqaba         9,129,925         Alawi Standi Um Udi         1,270,500         10         East Um Hebal         100,000,000         9b         Dabaa         65,289,261           Wadi Um Udi         1,270,500         Wadi Arab         8         North and Central In,000,000         10,000,000         9a         Dabaa         65,289,261           Aweirsha         2 26,592,843         2 8,378,825         2 8         North and Central In,000,000         9a         Dabaa         12,558,000           West         2 8,378,825         2 8,378,825         2 8,378,825         2 8,378,825         2 8,378,825         2 8,378,825         2 8,378,825         2 8,378,825         2 8,378,825         2 8,378,825         2 8,378,825         2 8,378,825         2 8,378,825         2 8,378,825         2 8,378,825         2 8,378,825         2 8,378,825         2 8,378,825         2 8,378,825         3 8,378,825         3 8,378,825         3 8,378,825         3 8,378,825         3 8,378,825         3 8,378,825         3 8,378,825         3 8,378,825         3 8,378,825	Wadil Um Udi         1,270,500         Total Proved Reserve         7,765,380         Total Geological         32,917,500           Um Esh         3,899,438         5 Aswan - K. 21         3,000,000         9b         Dabaa         5,289,261           Ras Aqaba         9,129,925         Alawi         K. 23         12,000,000         9b         Dabaa         65,289,261           Wadi Um Udi         1,270,500         Wadi Arab         Belda Um Udi         1,270,500         Belda Um Udi         1,000,000         9a         Dabaa         65,289,261           Wadi Um Udi         1,270,500         Belda Um Udi         1,270,500         Belda Um Udi         1,000,000         9a         Dabaa         12,558,000           Wadi Um Udi         1,270,500         Awai Arab         Arab         Arab         Belda Um Udi         11,000,000         9a         Dabaa         12,558,000           West         26,592,843         26         26         29         12         End Khor Rahma         11,000,000         West         12,558,000           Allawi         25         6,073,550         2         26,073,550         2         240,000,000         3a         Dabaa         12,589,000           Allawi         26         20,73,550	Wadd Agag         5.159,700         Total Proved Reserve         74,765,380         Total Geological Reserve         32,917,500           Um Esh         3,899,438         6 Alaqi         K. 21         3,000,000         9b         Dabaa         65,289,261           Ras Aqaba         9,129,925         Alaqi         K. 23         12,000,000         9b         Dabaa         65,289,261           Gabal Timsah         1,270,500         Wadi Madi Arab         Bert Wadi	Agag         5,159,700         Total Proved         74,765,380         Total Geological         32,917,500           Um Esh         3,899,438         6 Alaqi         K.21         3,000,000         9b         Dabaa         65,189,261           Ras Aqaba         9,129,925         7 Road         K.23         12,000,000         9b         Dabaa         65,189,261           Wadi Um Udi         1,270,500         Wadi Um Udi         1,270,500         Beida Um Rebal         10,000,000         East Wadi Arab         R8,000,000         Past Wadi Arab         Beida Um Rest         Bast Wadi Arab         Bast Wadi Arab <td>  Cocality   Reserve   Exploration Phases   Locality   Reserve (in tonage)   Reserve (in tonage)   Locality   Reserve (in tonage)  </td> <td>Reserves (Before 1976)         Working Group         EGSMA         Geology Department           Locality         (in Tonage)         Exploration Phases         Locality         Reserve (in tonage)         Locality         Reserve (in tonage)         New Estimated           North Wadi         1,068,813         2         South Aweirsha         11,953,689         9c         Rod El Kabash         32,917,500           Abu Subeira         8,032,500         2         Um Huqban         12,784,750         12,784,750</td> <td></td> <td></td> <td></td> <td><del>-</del></td> <td>34,430,119</td> <td>Allawi</td> <td>4</td> <td></td> <td>1,419,000</td> <td><math>\perp</math></td>	Cocality   Reserve   Exploration Phases   Locality   Reserve (in tonage)   Reserve (in tonage)   Locality   Reserve (in tonage)	Reserves (Before 1976)         Working Group         EGSMA         Geology Department           Locality         (in Tonage)         Exploration Phases         Locality         Reserve (in tonage)         Locality         Reserve (in tonage)         New Estimated           North Wadi         1,068,813         2         South Aweirsha         11,953,689         9c         Rod El Kabash         32,917,500           Abu Subeira         8,032,500         2         Um Huqban         12,784,750         12,784,750				<del>-</del>	34,430,119	Allawi	4		1,419,000	$\perp$
Wadi Abu         5,159,700         Allawi         34,430,119         Total Proved         74,765,380         Total Geological         32,917,500           Wadi Abu         5,159,700         5,159,700         Aswan - K. 21         3,000,000         Paserve         3,899,438         5,159,700         Aswan - K. 21         3,000,000         Paserve         3,899,438         5,159,700         Aswan - K. 21         3,000,000         Paserve         3,899,438         6,5189,261         Aswan - K. 21         3,000,000         Paserve         Asserve         6,789,261         Aswan - K. 21         3,000,000         Paserve         6,289,261         Asserve	Um Esh         5,159,700         4         Allawi         34,430,119         Total Geological         32,917,500           Wadi Abu         5,159,700         7         Reserve         7,765,380         Total Geological         32,917,500           Ras Aqaba         9,129,925         Aswan - K. 21         3,000,000         Baserve         Beserve         Beserve           Ras Aqaba         9,129,925         Aswan - K. 21         12,000,000         Baserve         Asserve         Beserve         Beserve           Awaii Um Udi         1,270,500         Bestrongolio         Bastrongolio         Astrongolio         Bastrongolio         Astrongolio         Astrongolio         Bastrongolio	Wadi Abu         5,159,700         4         Allawi         34,430,119         Total Geological         32,917,500           Um Esh         5,159,700         Reserve         7,894,38         5         Aswan - R. 21         3,000,000         9b         Dabaa         55,289,261           Ras Aqaba         9,129,925         Aswan - R. 21         3,000,000         9b         Dabaa         65,289,261           Ras Aqaba         9,129,925         Alaqi         K. 29         9,000,000         9b         Dabaa         65,289,261           Ras Aqaba         1,270,500         Wadi Um Udi         1,270,500         Bast Um Hebal         100,000,000         Bast         Bast           Aweirsha         2 26,592,843         Same Hugban         Same Hugban         Rasat Wadi         Rasat Wadi         Rasat Wadi         Rasat Wadi         Rasat Wadi         Rasat           Hugban         2 6,073,550         Alawi	Wadi Abu         5,159,700         Total Proved         74,765,380         Total Geological         32,917,500           Wadi Abu         5,159,700         Reserve         7,430,119         Reserve         7,4765,380         Total Geological         32,917,500           Ras Aqaba         9,129,925         Aswan - K. 21         3,000,000         9b         Dabaa         65,289,261           Ras Aqaba         9,129,925         Aswan - K. 21         12,000,000         9b         Dabaa         65,289,261           Wadi Um Udi         1,270,500         Best Um Hebal         100,000,000         Bast Um Hebal         100,000,000         Bast           Wadi Um Udi         1,270,500         Best Wadi Arab         Best Wadi Arab         Bast Wadi Arab	Cocality   Reserve   Exploration Phases   Locality   Reserve   Exploration Phases   Locality   Reserve   Exploration Phases   Locality   Reserve   Exploration Phases   Locality   Reserve   Locality   Reserve   Rese	Reserve   Exploration Phases   1,418,750     South Wadi   South Wadi   South Wadi   8,032,500     Construct   Reserve   Exploration Phases   1,068,813     Construct   Reserve   1,068,813     Construct   Reserve									000	4
Um Barmil         1,419,000         P. 90         4         Allawi         34,430,119         Total Geological         32,917,500           Wadi Abu         5,159,700         Agag         5,159,700         Asswan - R. 21         3,000,000         P. 8eserve         32,917,500           Bas Aqaba         9,129,925         Aswan - R. 21         3,000,000         P. 20         Aswan - R. 21         3,000,000         P. 20           Gabal Timsah         21,490,000         Berat Um Hebal         1,000,000         P. 20         Berat Um Hebal         1,000,000         P. 20           Wadi Um Udi         1,270,500         Berat Um Hebal         1,000,000         P. 20         Berat Um Hebal         1,000,000         P. 20           Wadi Araban         Berat Wadi         Berat Wadi         88,000,000         P. 20         Araban         Araban         11,000,000         West         12,558,000           Allawi         Berat Likham         7,000,000         P. 20,000,000         P. 20,000,000         West         Araban         Araban         Araban         Araban         Araban         Araban         Berat Tikham         7,000,000         West         Araban         Araban         Araban         Araban         Araban         Araban         Araban         Araba	Um Barmil         1,419,000         P. 90         4         Allawi         34,430,119         Total Geological         32,917,500           Wadi Abu         5,159,700         Agag         5,159,700         Asserve         74,765,380         Total Geological         32,917,500           Wadi Aba         5,159,700         Asserve         5 Aswan - K. 21         3,000,000         9b         Dabaa         65,289,261           Ras Aqaba         9,129,925         7 Road         K. 29         9,000,000         9b         Dabaa         65,289,261           Wadi Um Udi         1,270,500         10         East Wadi         8,29         9,000,000         Bast         Bast         Bast Wadi         Bast         Bast <td>Um Barmil         1,419,000         P. 90         4         Allawi         34,430,119         Total Geological         32,917,500           Wadi Abu         5,159,700         Agag         5,159,700         Asserve         7,300,000         P. 90         Total Froved         74,765,380         Total Geological         32,917,500           Ras Agaba         Si,899,438         Si,899,438</td> <td>Um Barmil         1,419,000         P.90         4         Allawi         34,430,119         Total Geological         32,917,500           Wadi Abu         5,159,700         Asyman         K. 21         3,000,000         P. 20,29,226         Total Geological         32,917,500           Ras Aqaba         9,129,925         Asyman         K. 21         3,000,000         P. Dabaa         65,289,261           Ras Aqaba         9,129,925         Asyman         K. 21         3,000,000         P. Dabaa         65,289,261           Ras Aqaba         9,129,925         Asyman         K. 22         12,000,000         P. Dabaa         65,289,261           Wadi Um Udi         1,270,500         Best Wadi         R. 29         9,000,000         P. Dabaa         65,289,261           Aweirsha         Bestad Um         Arab         Bast Wadi         R. 29         9,000,000         P. Dabaa         Dabaa           Aweirsha         Bestad Um         Arab         Arab         Bast Wadi         Arab         Bast Wadi         Arab         Arab         Arab         Arab         Arab         Arab         Arab         Arab         Arab</td> <td>  Cocality   Reserve   Exploration Phases   Locality   Reserve (in tonage)   Locality   Reserve (in</td> <td>  Working Group   EGSMA   Geology Department    </td> <td></td> <td></td> <td></td> <td></td> <td>12,784,750</td> <td>Um Huqban</td> <td>ю</td> <td></td> <td>8,032,500</td> <td></td>	Um Barmil         1,419,000         P. 90         4         Allawi         34,430,119         Total Geological         32,917,500           Wadi Abu         5,159,700         Agag         5,159,700         Asserve         7,300,000         P. 90         Total Froved         74,765,380         Total Geological         32,917,500           Ras Agaba         Si,899,438	Um Barmil         1,419,000         P.90         4         Allawi         34,430,119         Total Geological         32,917,500           Wadi Abu         5,159,700         Asyman         K. 21         3,000,000         P. 20,29,226         Total Geological         32,917,500           Ras Aqaba         9,129,925         Asyman         K. 21         3,000,000         P. Dabaa         65,289,261           Ras Aqaba         9,129,925         Asyman         K. 21         3,000,000         P. Dabaa         65,289,261           Ras Aqaba         9,129,925         Asyman         K. 22         12,000,000         P. Dabaa         65,289,261           Wadi Um Udi         1,270,500         Best Wadi         R. 29         9,000,000         P. Dabaa         65,289,261           Aweirsha         Bestad Um         Arab         Bast Wadi         R. 29         9,000,000         P. Dabaa         Dabaa           Aweirsha         Bestad Um         Arab         Arab         Bast Wadi         Arab         Bast Wadi         Arab         Arab         Arab         Arab         Arab         Arab         Arab         Arab         Arab	Cocality   Reserve   Exploration Phases   Locality   Reserve (in tonage)   Locality   Reserve (in	Working Group   EGSMA   Geology Department					12,784,750	Um Huqban	ю		8,032,500	
South Wadi Abu   Su32,500   Page   3   Um Huqban   12,784,750   Page   4   Allawi   24,430,119   Page   Ageingh   24,430,119   Page	South Wadi Abu   Sou	South Wadi         Abu Subside         8,032,500         Abu Subside         3         Um Huqban         12,734,750         Colar Investor         12,734,750         Abu Subside         Abu Su	South Wadi Abu   Wadi Abu   S.159,700   P.99   4   Allawi   Beriat Um Barmi   1,419,000   P.99   Allawi   Beriat Um Barmi   1,419,000   P.99   Allawi   Beriat Um Barmi   1,419,000   P.99   Allawi   Beriat Um Barmi   1,000,000   P.90   Allawi   East   Allawi   East   East   Barmi   Barmi   East   East   Allawi   East	Cocality   Reserve   Exploration Phases   Locality   Reserve (in tonage)   Locality   Reserve (in	Working Group   EGSMA   Geology Department										Aou Suberra
South Wadi         Abu Subeira         8,032,500         Abu Subeira         3,000,000         Abu Subeira         12,784,750           Abu Subeira         8,032,500         Abu Subeira         3,4430,119         Total Geological         32,917,500           Wadi Abas Subeira         3,899,438         Secretaria         Aswan - Reserve         7 Aswan - Roserve         7 Aswan - Roserve         12,000,000         Past Reserve           Bas Agaba         9,129,935         Aswan - Roserve         7 Aswan - Roserve         7 Aswan - Roserve         12,000,000         Past Reserve           Abadi Um Udi         1,270,500         Beriad Um Hebal         10,000,000         Bast Um Hebal         100,000,000         Bast Um Hebal         100,000,000           Wadi Um Udi         1,270,500         Beriad Um Hebal         10,000,000         Bast Um Hebal         100,000,000         Bast Um Hebal         100,000,000           Wadi Um Udi         1,578,825         General Um Hebal         10,000,000         Bast Um Hebal         11,000,000         West           Allawi         26,592,843         General Um Hebal         11,000,000         West         Dabaa         12,588,000           Allawi         26,692,843         General Um Hebal         11,000,000         West         Total Geological         T	South Wadi   Abu Subeira   8,032,500   Abu Subeira   8,032,500   Abu Subeira   8,032,500   Abu Subeira   1,419,000   Abu Subeira   1,51,419,000   Abu Subeira   1,51,419,000   Abu Subeira   1,51,419,419   Abu Sube	South Wadi         South Wadi         8,032,500         Alawi         3         Um Huqban         12,784,750         Dabaa         12,784,750           Abu Subeira         8,032,500         Alami         3,430,119         Total Geological         32,917,500           Wadi Um Esh         3,899,438         S Aswan - K. 21         3,000,000         Paserve         Reserve           Um Esh         3,899,438         S Aswan - K. 21         3,000,000         Paserve         Reserve           Um Esh         3,899,438         S Aswan - K. 21         3,000,000         Paserve         Reserve           Ras Aqaba         9,129,925         Aswai Laban         R. 23         13,000,000         Paserve           Gabal Timsah         21,490,000         Paserve         Reserve         Reserve         Reserve           Aweirsha         East Wadi         Reserve         Reserve         Reserve         Reserve           Hugban         East Wadi         Reserve         Reserve         Reserve         Reserve           Allawi         East Wadi         Reserve         Reserve         Reserve         Reserve           Allawi         1,803,813         Reserve         Total         Total         Total	South Wadin Abu Subeira         8,032,500         Sec T South Wadin Abu Subeira         3 Um Huqban         12,784,750         12,784,750           Abu Subeira         8,032,500         Abu Subeira         34,430,119         Total Proved         74,765,380         Total Geological         32,917,500           Wadi Um Esh         3,899,438         Saswar         Saswar         K. 21         3,000,000         Pb Dabaa         65,289,261           Ras Aqaba         9,129,925         Aswar         Aswar         K. 29         9,000,000         Pb Dabaa         65,289,261           Wadi Um Udi         1,270,500         Belda Um B	Working Group   EGSMA   Geology Department	Working Group   EGSMA   Geology Department					11,953,689	South Aweirsha	7		1,068,813	
North Wadi   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,068,813   1,0	South Wadi	South Wadi	South Wadi   Substitute   Sub	Working Group   EGSMA   Geology Department	Working Group   EGSMA   Geology Department		32,917,500		36	15.596,822	North Aweirsha	-	(	11,410,/50	No at We at
North Watch   1,068,813   C   1   North Aweirsha   15,596,822   9c   Rod El Kabash   32,917,500     North Watch   1,068,813   1,068,813   1,068,813     South Watch   1,419,000   2   South Aweirsha   11,535,689     Watch Shaba   2,129,205   2   South Aweirsha   11,784,750     Watch Machi   1,219,000   2   South Aweirsha   1,209,000     Watch Machi   1,219,205   2   South Aweirsha   1,209,000     Watch   1,219,205   2   South Aweirsha   1,309,438     Wasch   1,219,205   2   South Aweirsha   1,300,000     Wasch   1,309,438   2   South Aweirsha   1,309,000     Wasch   1,309,000   2   South Aweirsha   1,300,000     Wasch   1,309,000   2   South Aweirsha   1,300,000     Wasch   1,219,205   2   South Aweirsha   1,300,000     Wasch   1,309,000   2   South Aweirsha   1,300,000     Wasch   1,309,000   2   South Aweirsha   1,300,000     Wasch   1,309,000   2   South Aweirsha   1,309,000     Wasch   1,309,000   2   South Aweirsha   1,300,000     Wasch   1,309,000   1   South Aweirsha   1,300,000     Wasch   1,300,000   1,300,000   1,300,000     Wasch   1,300,000   1,300,000   1,300,000     Wasch   1,300,	North Watis   1,068,813   North Aweirsha   15,596,822   9c   Rod El Kabash   32,917,500     Abu Subeira   1,068,813   Abu Subeira   1,068,813     South Wadi   S. 159,700   P. 9.     Wadi Abu   S. 159,700   Wadi Abu   S. 159,2538     Wadi Um Udi   1,270,500   Wadi Um Udi   1,270,500     Wadi Um Udi   1,270,500   Wadi Abu   S. 159,21,250   S. 129,21,300     Wadi Um Udi   1,270,500   Wadi Abu   S. 159,21,250   S. 120,000,000   Beida Um   S. 159,51,250   S. 120,000,000   Beida Um   S. 159,51,250   S. 120,000,000   S. 159,51,250   S. 120,000,000	North Watersha   1,068,813   North Aweirsha   15,596,822   9c   Rod El Kabash   32,917,500     North Watersha   1,068,813   North Aweirsha   11,536,822   9c   Rod El Kabash   32,917,500     South Watersha   1,419,000   Pag   American   11,784,750     Um Esh   3,899,438   Sanda   1,299,225     Water   Labol Ondo	North Americal Abu Subeira   1,068,813   South Awerisha   15,596,822   9c Rod El Kabash   32,917,500     Abu Subeira   1,068,813   South Awerisha   1,953,689   South Awerisha   1,953,689   South Awerisha   1,953,689     Abu Subeira   1,068,813   South Awerisha   1,1953,689   South Awerisha   1,1950,000     Abu Subeira   1,419,000   Prog   A	Working Group EGSMA Geology Department Cairo University Carloration Phase Locality Re-evaluated Locality New Estimated	Working Group  Exploration Phases  Working Group  Exploration Phases  Working Group  Exploration Phases  Locality  Re-evaluated  Locality  New Estimated		Reserve (in tonage		-	Reserve (in tonage)		ŀ		11 410 750	1 Nila Vallay
Nile Valley   11,418,750	Nile Valley   11,418,750   North Wadia   North Aweirsha   North Aweirsha   North Aweirsha   North Aweirsha   North Wadia   No	Nile Valley         11,418,750         Nile Valley         11,418,750         Reserve (in long serve lange)         12,596,832         9c         Rod El Kabash         Reserve (in long serve lange)           South Wadi         3,033,500         2         South Aweirsha         11,953,689         9c         Rod El Kabash         32,917,500           Abu Subeira         8,032,500         2         Um Huqban         12,784,750         Reserve         32,917,500           Um Barmil         1,419,000         Pag         4         Allawi         34,430,119         Reserve         32,917,500           Um Barmil         1,419,000         Pag         4         Allawi         34,430,119         Reserve         32,917,500           Um Esh         3,899,438         S         Alsamal         K. 21         3,000,000         Page         Dabaa         65,289,261           Ras Aqaba         2,129,226         S         Alsamal         K. 29         9,000,000         Page         Alsamal           Wadi Um Udi         1,270,500         Beda Um         Madi Arab         Reserve         Dabaa         12,558,000           West         26,521,280         Beda Um         Madi Arab         110,000,000         Page         Dabaa         12,558,000	Nile Valley         11,418,750         Hoserve (in tonage)         1 North Aweirsha         Aveirsha         Aveirsha         15,596,832         9c         Rod El Kabash         Acserve (in tonage)           South Wadi         1,068,813         Hoge 1         2 South Aweirsha         11,953,689         9c         Rod El Kabash         32,917,500           Abu Subeira         8,032,500         Page 1         3 Um Huqban         11,953,689         7 Rod El Kabash         32,917,500           Um Barmii         1,419,000         Page 1         Aswan - Roserve         K. 21         3,000,000         Paserve           Um Esh         3,899,438         S Aswan - Roserve         K. 21         3,000,000         Paserve           Um Esh         9,129,925         Aswai Lun Um Esh         11,400,000         Pabaa         65,289,261           Ras Aqab Timsha         11,270,500         Bast Um Hebal         100,000,000         Page 5         Page 6           Awei Um Udi         1,270,500         Bast Um Hebal         11,000,000         Page 5         Dabaa         65,289,261           Heidan         Beida Um Reserve         Bart Wadi         Raserve         Bart Wadi         Barqat Tukham         7,000,000         Page 5           Allawi         C 6,073,550	Working Group EGSMA	Working Group  EGSMA		New Estimated	Locality		Re-evaluated	Locality		Exploration Phases	(in Tonage)	Locality
Nie Valley   (in Tonage)   Exploration Phases   Locality   Reserve (in tonage)   Locality   Local	Nie Valley   (in Tonage)   Exploration Phases   Locality   Reserve (in tonage)   Locality   Local	Nile Valley   (in Tonage)   Exploration Phase   Locality   Reserve (in tonage)   Nile Valley   In Tonage   In North Aweirsha   Is.596,822   9c   Rod El Kabash   32,917,500     North Wadi Abu Subeira   1,068,813   19,000   2   South Aweirsha   11,953,689   9c   Rod El Kabash   32,917,500     Abu Subeira   8,032,500   Agag   2   South Aweirsha   11,953,689   9c   Rod El Kabash   32,917,500     Abu Subeira   8,032,500   Agag   2   South Aweirsha   1,139,000   Agag   2   South Aweirsha   1,139,000   Agag   2   South Aweirsha   1,139,000   Agag   2   South Aweirsha   2,139,000   Agag   2   South Aweirsha   2,130,000   Agag   2   South Aweir	Nie Valley   (in Tonage)   Exploration Phase   Locality   Reserve (in Innage)   New Estimated	Working Group EGSMA	Working Group  EGSMA		Iversity	Cairo Un	1				/	Recente	,
Locality   Reserve   Locality	Locality   Reserve   Locality	Locality   Reserve   Locality   Reserve   Locality   Reserve (in tonage)   Locality   Locality   Reserve   Locality   Reserve   Locality   L	Locality   Reserve   Locality   Locality   Reserve   Locality   Reserve   Locality   Loca	(1993 – 1997)	Working Ground (1993 – 1997)		partment	Geology De		MA	EGSI				
Locality   Reserve   Locality   Locali	Locality   Reserve   Locality   Loca	Locality   Reserve   Cairo University   Cairo Un	Locality   Reserve   Cairo University   Locality   Locality   Locality   Locality   Locality   Locality   Reserve   Locality							(1993 - 1997)			(A)		

Table (3): The previously recorded and newly discovered & re-evaluated iron ore reserves of Aswan Region

type (5-10 m thick) at the base of the Lutetian Naqb Formation. Fortunately the exploratory pits and wells proved the occurrence of these types in the first four sectors.

After the discovery was achieved in south El Gedida and NE El Harra sectors, a close network of wells was penetrated and the geological reserves calculated as shown in Table 4 (IEP achievements in F:I Bahariya Region, 1993 - 1997). Table 4 also includes the previously known ore reserves recorded by EGSMA (1969 – 1971) and UEC (1976), as well as the results of the recent (1987-1997) re-evaluations of the ISCO in Nasser 2 and El Gedida mine areas.

#### **ACHIEVEMENTS OF IEP**

The main achievements of the Iron Exploration Project (IEP 1993 – 1997) can be summarized as follow:

- I. The IEP clarified the stratigraphy, structure and genesis of the iron ore deposits in Aswan and El Bahariya Regions. Areas worthy of exploration were delineated in both, but with different approaches, since the mode of occurrence of the iron ore deposits in Aswan Region differs from that in El Bahariya Region.
- 2. The Work Groups integrated the various disciplines of earth sciences to achieve the main goal of this project, i.e. finding new iron ore reserves. IEP added more iron ore reserves totaling about 350 mt (geological reserves) to Aswan, in the south and southeastern sectors, and about 35 mt to El Bahariya Region.
- 3. The national economy will benefit from the new discoveries of the IEP. The new iron ore occurrences of Aswan feature in the future planning and development of the region south of Aswan. The El Bahariya findings extended the life of El Gedida mine in the Western Desert.
- 4. The IEP formulated a basis of positive and successful cooperation between governmental institutions, industrial companies (e.g. EGSMA and, HCMI and ISCO, respectively) and research centers i.e. Geology Department, Cairo University. Those engaged in this project re-examined the older genetic models, and experimented with newly introduced concepts, regarding ore genesis.
- 5. Academic benefits: the young IEP trained geologists from Cairo University, EGSMA and ISCO, and undergraduate students during the field and laboratory studies and investigations. This ferment will grow during the years to come and will generate effective researchers in similar projects.
- 6. Three Ph.D, and three M.Sc. research programs, on the iron ore deposits and the associated rocks of El Bahariya and Aswan, were supported by the IEP facilities, and the scientific materials realised through the project. Two Ph.D. and two M. Sc. degrees have been awarded during the last few years.

#### IEP RECOMMENDATIONS

#### Aswan Region:

I. The extension of the economic oolitic ironstones east and southwards of Aswan should be followed based on the geological parameters outlined in the IEP Reports. The regional southward and south – eastward extensions of the discovered ore occurrences, particularly along Wadi Garrara – Gabal Abraq graben and Aswan Allaqi sector (until lat. 22°) are considered a promising area, recommended for further exploration and prospection.

						Reserve	Reserves (m.t.)	
Area	Area	Overb.	Iron Ore	Cut off		9-	-by-	
	km,	Thickness	Thickness	Grade Fe %	EGSMA	UEC	ISCo.	IEP
:	000	(av., III)	(av.,m).		(1969 - 19/1)	(1976)	(1987 - 1997)	(1993-1997)
Chorabi	2.308	0.1 - 2.0	11.1	40%	55,528,840	56,971,689		
Nasser	1.203	0.1 - 20.0	12.68	30% (25%)	28,990,760	26,023,281		
Nasser (2) New discovery by ISCo. 1989				30%			10,044,356 7,856,000	
ЕС Нагга	2.9	5.90	8.0	30%	53,744,291	61,226,230		
NE-EL Harra (new discovery by IEP, 1997)	2.4			40%				16,302,809 (40% Fe) 22,937,730 (Fe% ?)
El Gedida	6.464	7.20	10.52	40 %	117,000,000	123,718,000	148,640,358 (re-evaluation)	
South El Gedida (new discovery by IEP, 1995).	0.5			-				12,650,497 (geological
Additional							37 076 717	35 589 777
Treselves		1					24,220,714	177,000,00

Table (4): Summary of the estimated ore reserves of the known occurrences and the new discoveries of El Bahariya

Additional Reserves by ISCo.: (Nasser 2+ Re-evaluation of EL Gedida) = 34,926,714

Additional Reserves by IEP (NÈ EL Harra, & S. EL Gedida) = 35,588,227 Total additional reserves (ISCo + IEP.) = 70,514,941

NE El Harra block (22,937,730 t) = 16,302,809 with 40%Fe + 6,634,921 t (Fe% is not yet available)

- 2. The essential geological reserves for the discovered ore occurrences must be proved, through detailed trenching and shallow drilling programs.
- 3. The microscopic examinations of representative thin and polished sections of samples and concentrates are highly recommended to be continued, before and during the further estimation and industrial evaluation and dressing of the discovered ores, taking into consideration the mineralogical and textural parameters (interlocking indices) described and documented in the present work or characterizing the produced concentrates. This will help a lot in the suitable dressing techniques of such ores, in order to avoid the complications and contaminations of the produced concentrates.

#### El Bahariya Region:

- 4. Further detailed field investigations due north of El Gedida mine (North El Gedida El Ghaziya Sector) is to continue, since this sector shows geological features suitable for iron ore formation
- 5. Drilling in the sectors to the east and west of El Gedida mine is to continue to add more reserves.
- 6. Drilling along the NE master faults of the northeastern plateau of E1 Bahariya Depression (Ghorabi El Bahr and El Harra El Gedida Faults) is highly recommended, to follow up the subsurface topography of the Cenomanian clastics and associated economic ironstone bands.

#### Acknowledgments

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#### M. M. El Aref

**and provided** the necessary guidance for, the achievement of the Project aims.

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